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Role of Public-Private Partnerships in Enhancing Sustainable Agricultural Projects in Rwanda

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Abstract

This study examines the role of public-private partnerships (PPPs) in enhancing sustainable agricultural projects in Rwanda, using the Twigire Muhinzi initiative as a case study. Adopting a mixed-methods approach, the research combined both quantitative data from structured questionnaires and qualitative data from key informant interviews. The study found that PPPs significantly contributed to the provision of agricultural inputs, capacity building, and the establishment of market linkages. However, challenges such as limited coordination, inadequate funding, and policy constraints hinder the full potential of PPPs. The study recommends improved coordination among stakeholders, increased financial investment, and policy reforms to enhance PPP effectiveness in agriculture.

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Keywords; Sustainable Agriculture, Public private partnership, projects, Rwanda, climate change

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1. Introduction

Agriculture remains a cornerstone of Rwanda's economy, contributing significantly to livelihoods and food security (MINECOFIN, 2021). Despite its importance, smallholder farmers face persistent challenges, including declining soil fertility, limited access to extension services, and inadequate adoption of improved agricultural technologies. To address these issues, the Twigire Muhinzi agricultural extension model was introduced as a homegrown solution, emphasizing decentralized, farmer-to-farmer knowledge sharing. However, achieving the full potential of this model requires effective collaboration among public and private stakeholders.

Public-private partnerships (PPPs) have gained global recognition for their potential to mobilize resources, enhance efficiency, and foster innovation in various sectors, including agriculture. By combining the strengths of public institutions and private entities, PPPs can overcome resource constraints and improve service delivery. In Rwanda, the Twigire Muhinzi project leverages PPPs, notably the collaboration between the Rwanda Agriculture and Animal Resources Development Board (RAB) and One Acre Fund (TUBURA). This partnership aims to enhance agricultural productivity through activity planning, stakeholder engagement, and technology transfer.

Previous studies highlight the role of PPPs in agriculture, including their impact on technology adoption and stakeholder participation. For instance, Ponnusamy (2016) and Kale et al. (2022) emphasize the need for inclusive partnerships to drive sustainable agricultural development. However, limited research exists on the specific contributions of PPPs to agricultural extension systems in Rwanda. This gap underscores the need for focused studies that explore how PPPs influence the performance of initiatives like Twigire Muhinzi.

This study seeks to evaluate the role of PPPs in improving the performance of the Twigire Muhinzi project, focusing on three dimensions: activity planning, stakeholder engagement, and technology transfer. By examining these factors, the research provides actionable insights for policymakers and practitioners aiming to enhance agricultural extension systems and foster

2. Literature Review

Public-private partnerships (PPPs) have emerged as a transformative approach in agricultural development, bridging resource and capacity gaps between the public and private sectors. This section examines key theoretical foundations and empirical studies that inform the role of PPPs in activity planning, stakeholder engagement, and technology transfer within agricultural projects.

2.1 Theoretical Foundations

Project planning theory highlights the importance of structured frameworks in ensuring project success. Fayol's early principles of planning emphasize setting goals, allocating resources, and coordinating activities to achieve desired outcomes. In the context of agricultural projects, effective planning aligns activities with seasonal cycles, stakeholder needs, and available resources, ensuring timely implementation and measurable impacts (Reijniers, 1994; Clifton & Duffield, 2006).

Freeman's stakeholder theory (1984) underlines the need to balance diverse stakeholder interests in project management. Engagement fosters collaboration, trust, and resource sharing, critical for achieving shared objectives. In agricultural PPPs, involving stakeholders such as farmers, agronomists, and private partners enhances project ownership and aligns activities with community needs (Kujala et al., 2022).

The TAM framework posits that perceived usefulness and ease of use drive technology adoption. In agriculture, technology transfer involves disseminating innovations that improve productivity, such as improved seeds or pest control methods. Successful technology adoption depends on tailored training and support systems that address farmer needs and capacities (Davis, 1989).

Studies consistently link effective activity planning with improved sustainable agricultural projects. Khodakarami and Esmaeli (2021) demonstrated that well-structured plans increase the likelihood of completing projects on time and within budget. In agriculture, timely planning is critical to aligning interventions with planting seasons and resource availability (Magassouba et al., 2019). However, gaps in participatory planning can lead to inefficiencies, as highlighted in East African PPPs, where top-down approaches often exclude local stakeholders (Adebayo et al., 2020).

Empirical evidence underscores the importance of stakeholder engagement in agricultural projects. Aranda et al. (2022) found that high levels of stakeholder participation correlate with successful project outcomes. However, challenges such as unequal power dynamics and limited capacity among stakeholders can hinder meaningful engagement. In Rwanda, studies by Musabyimana (2016) and Kabirigi (2022) emphasize the need for inclusive approaches that involve women, youth, and marginalized groups in agricultural extension systems.

The role of technology transfer in agricultural productivity is well-documented. Bhowmik and Sharma (2022) found that projects facilitating effective knowledge transfer had higher adoption rates of improved technologies among smallholder farmers. Similarly, Adhikari and Poudel (2022) showed that targeted training and accessible resources enhance the uptake of agricultural innovations. However, challenges such as inadequate training and resource constraints often limit the impact of technology transfer initiatives (Pandey et al., 2021).

While existing studies provide valuable insights, few examine the specific contributions of PPPs to agricultural extension systems in Rwanda. The Twigire Muhinzi model, as a decentralized farmer-to-farmer extension approach, presents a unique opportunity to assess the interplay between PPPs and agricultural sustainable agricultural projects. This study addresses this gap by evaluating how PPPs influence activity planning, stakeholder engagement, and

technology transfer within the Twigire Muhinzi initiative.

3. Methodology

This study employed a descriptive-correlational design to examine the role of public-private partnerships (PPPs) in the performance of the Twigire Muhinzi agricultural project in Rwamagana District, Rwanda. The descriptive approach provided an overview of project characteristics, while the correlational analysis explored the relationships between activity planning, stakeholder engagement, technology transfer, and sustainable agricultural projects.

The target population consisted of 614 stakeholders involved in the Twigire Muhinzi initiative, including project coordinators, public agronomists, socio-economic development officers (SEDOs), farmer field school (FFS) facilitators, and farmer promoters. A sample size of 237 was determined using Taro Yamane's formula, ensuring representation across all stakeholder groups. Stratified random sampling was applied to ensure proportional representation, while census sampling was used for small categories like project coordinators and district agronomists.

Primary data were collected using structured questionnaires designed to capture respondents' views on PPP roles in activity planning, stakeholder engagement, and technology transfer. The questionnaire used a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree." To enhance data quality, a pilot test involving 20 respondents was conducted, yielding a Cronbach's Alpha reliability score of 0.88. Secondary data were obtained from project

Quantitative data were analyzed using descriptive statistics (means, standard deviations) and inferential statistics, including correlation and multiple regression analyses. The regression model assessed the predictive influence of the independent variables—activity planning, stakeholder engagement, and technology transfer—on the dependent variable, sustainable

agricultural projects. Analysis was conducted using R statistical software.

The regression equation was structured as:

$Y=\beta0+\beta1X1+\beta2X2+\beta3X3+eY = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + eY=\beta0 +\beta1X1+\beta2X2+\beta3X3+e$

Where:

- YYY: Sustainable agricultural projects
- X1,X2,X3X_1, X_2, X_3X1,X2,X3: Activity planning, stakeholder engagement, and technology transfer
- β0,β1,β2,β3\beta_0, \beta_1, \beta_2, \beta_3β0,β1,β2,β3: Coefficients
- e: Error term

Ethical approval was obtained from the University of Kigali. Participation was voluntary, with respondents providing informed consent before data collection. Anonymity and confidentiality were ensured by coding responses and securely storing data. No respondents under the age of 18 were included. The study adhered to research ethics principles, including respect for participants and data integrity.

4. Results

A total of 237 respondents were sampled, with 231 valid responses received, representing a response rate of 97.47%. This high response rate ensures the reliability of the findings.

Table 1: Response rate

Respondent Category	**Sample Size**	**Valid Responses**	**Response Rate (%)**
District Agronomists	1	1	100
Farmer Field School Facilitators (FFS)	12	12	100
Farmer Promoters	195	189	97
Sector Agronomists	6	6	100
Socio-Economic Development Officers	20	20	100
Twigire Muhinzi Project Coordinators	3	3	100
Total	**237**	**231**	**97.47**

Source: Primary data (2024)

4.1 Descriptive Statistics

Table 2 summarizes the role of PPP in activity planning, stakeholder engagement, and technology transfer.

Table 2: Roles of PPP in activity planning, stakeholder engagement and technology transfer in summary

Statement	Mean	Standard Deviation
Seasonal activity planning is done on time.	4.26	0.57
Planning aligns with farmers' needs.	4.20	0.60
Information dissemination to stakeholders is clear and timely.	4.23	0.53
Data collection uses appropriate methods.	3.96	0.82
Stakeholder engagement improves project outcomes.	4.21	0.63
Technology transfer enhances agricultural productivity.	4.35	0.49

Source: Primary data (2024)

4.2.Inferential Statistics

4.2.1 Regression Analysis

A multiple regression analysis assessed the effect of PPP dimensions on sustainable agricultural projects.

Table 3: Multiple regression analysis in relation to the effect of PPP on sustainable agricultural projects

Variable	Coefficient (β)	p-value	Significance
Activity Planning	0.1788	0.0013	Significant
Stakeholder Engagement	0.1516	0.0087	Significant
Technology Transfer	0.5603	<0.0001	Significant

Source: Primary data (2024)

The model explained 60.39% of the variance in sustainable agricultural projects ($R^2 = 0.6039$). Technology transfer had the highest impact on sustainable agricultural projects, followed by activity planning and stakeholder engagement.

4.2.2 Correlation Analysis

Table 4: Correlation analysis

Variable Pair	Correlation Coefficient (r)	Significance
Activity Planning and Performance	0.42	Significant
Stakeholder Engagement and Performance	0.36	Significant
Technology Transfer and Performance	0.61	Significant

Source: Primary data (2024)

5. Discussion

The findings of this study reveal significant insights into the role of public-private partnerships (PPPs) in enhancing the performance of the Twigire Muhinzi agricultural project in Rwanda. These results align with existing literature while providing context-specific contributions to the understanding of PPP impacts in agricultural extension systems.

5.2.1 Activity Planning

The study demonstrates that activity planning significantly influences sustainable agricultural projects ($\beta = 0.1788$, $p = 0.0013$). This finding supports the conclusions of Khodakarami and Esmaeli (2021), who emphasized the importance of structured planning in achieving timely and cost-effective project outcomes. However, this study highlights the need for more

participatory approaches in planning to ensure alignment with farmer needs and seasonal cycles. Gaps in timely input delivery and data collection methods suggest opportunities for improvement in coordination and resource allocation.

5.2.2 Stakeholder Engagement

Stakeholder engagement was found to have a moderate but significant impact on sustainable agricultural projects ($\beta = 0.1516$, $p = 0.0087$). This aligns with Aranda et al. (2022), who noted the importance of collaboration and trust in successful project outcomes. However, the study also revealed gaps in inclusivity, particularly the underrepresentation of women and youth. These findings echo the observations of Musabyimana (2016), who identified similar challenges in Rwanda's agricultural projects. Future efforts should focus on fostering inclusivity and addressing power imbalances among stakeholders to enhance engagement.

5.2.3 Technology Transfer

Technology transfer emerged as the most influential factor ($\beta = 0.5603$, $p < 0.0001$), underscoring its critical role in improving agricultural productivity and sustainable agricultural projects. This finding is consistent with Bhowmik and Sharma (2022), who found that effective knowledge transfer leads to higher adoption rates of agricultural technologies. The success of Twigire Muhinzi in disseminating improved seeds and farming practices demonstrates the potential of PPP-driven technology transfer initiatives. However, challenges such as inadequate training and limited accessibility to resources highlight areas for refinement.

5.2.4 Comparison with Existing Knowledge

The findings are consistent with studies emphasizing the role of PPPs in mobilizing resources, fostering innovation, and enhancing service delivery (Kale et al., 2022; Pandey et al., 2021). However, this study provides a unique contribution by focusing on the Twigire Muhinzi

model, a farmer-to-farmer extension system that has received limited attention in previous research. The results underscore the importance of context-specific strategies in designing and implementing PPPs for agricultural extension.

6. Recommendations

Based on the findings of this study, the following recommendations are proposed to enhance the performance of the Twigire Muhinzi agricultural project and similar initiatives:

Activity Planning

- **Enhance Participatory Planning**: Involve stakeholders in the planning process such as seasonal planning meetings to ensure activities align with their needs and seasonal cycles.
- **Streamline Input Delivery**: Improve the logistics of input distribution, ensuring seeds and fertilizers reach farmers before the planting season begins.
- **Strengthen Data Collection Systems**: Adopt efficient and standardized data collection methods, such as digital tools, to improve accuracy and timeliness.

Stakeholder Engagement

- **Promote Inclusivity**: Actively encourage the participation of women, youth, and marginalized groups in all stages of the project to ensure broader representation and impact.
- **Improve Communication Channels**: Establish accessible, real-time communication platforms, such as SMS systems, to facilitate stakeholder updates and feedback.
- **Build Stakeholder Capacity**: Provide regular training sessions for farmer promoters and farmer field school facilitators to improve their effectiveness in delivering extension services.

Technology Transfer

- **Expand Training Programs**: Increase the frequency and coverage of training programs

to ensure all farmers can access and adopt new technologies effectively.

- **Improve Accessibility to Resources**: Provide subsidized or affordable access to improved seeds, fertilizers, and other agricultural inputs.
- **Monitor Technology Adoption**: Conduct regular follow-ups to assess the adoption and effectiveness of transferred technologies, making adjustments as needed.

General Recommendations

- **Strengthen PPP Frameworks**: Develop clear roles, responsibilities, and accountability measures for public and private partners to enhance collaboration and resource mobilization.

- **Scale Successful Practices**: Expand the Twigire Muhinzi model to other districts, incorporating lessons learned to address identified gaps.
- **Leverage Digital Tools**: Integrate digital solutions into planning, monitoring, and communication processes to improve efficiency and reach.

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